

Temporal trends in breast cancer mortality by state and race

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Abstract

Objective To examine how temporal trends in age-standardized female breast cancer death rates vary by state and race.

Methods We analyzed mortality data from the National Center for Health Statistics (NCHS) for the years 1975 through 2004 by state and race using joinpoint analyses.

Results By 2004, breast cancer death rates in white women were decreasing in all 50 states and the District of Columbia (DC), with the onset of decline varying by state. In contrast, among African American women, breast cancer death rates increased in two states (Arkansas and Mississippi) of the 37 states analyzed, were level in 24 states, and decreased in 11 states. In general, states that showed little progress in reducing breast cancer mortality rates over time had higher death rates in 2003–2004.

Conclusion Trends in breast cancer death rates vary widely by state and are considerably less favorable in African American than in white women. State cancer control efforts should ensure that all women have access to high-quality early detection and treatment services.

Keywords Breast cancer · Mortality · Trends · United States · African Americans

Introduction

Breast cancer death rates in women have decreased nationally in the United States since 1990, due to both

increased use of screening mammography and improvements in breast cancer treatment [1]. The decrease has been more rapid in white than in African American women resulting in a widening disparity. Factors that contribute to the higher death rate in African American women are believed to include differences in access to and utilization of detection and treatment, receipt of timely and high-quality treatment, risk factors that are differentially distributed by race or socioeconomic status, or biologic differences associated with survival [2].

Studies have also shown geographic variation in breast cancer mortality trends with larger decreases in the Northeast, Midwest, and West than in the South [3–5]. Reasons for regional variations in mortality trends are thought to include regional differences in breast cancer incidence, risk factors, screening, and treatment [2, 4–8]. However, no previously published studies have examined breast cancer mortality trends by state, where cancer control plans are developed and many of the policies that affect access to mammography and high-quality cancer care are implemented. The objective of this article is to examine how temporal trends in age-standardized female breast cancer death rates vary by state and race.

Materials and methods

Data on breast cancer incidence were obtained from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) nine oldest registries and are adjusted for reporting delay [9]. Delayed reporting generally affects the most recent 1–3 years of incidence data (in this case, 2002–2004). The NCI has developed a method to account for expected reporting delays in SEER registries when long-term incidence trends are analyzed

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[10]. Information on deaths from breast cancer during 1975 through 2004 was obtained from the SEER*Stat Database, as collected by the National Center for Health Statistics (NCHS) [11]. We calculated the age-standardized female breast cancer death rates (directly adjusted to the 2000 US standard population) for African American and white women in the combined years 2003 and 2004 by state using SEER*Stat software [12]. Death rates among African American women are not presented for 17 states with fewer than 25 breast cancer deaths in 2003–2004.

We used the joinpoint regression model to examine temporal trends in age-standardized female breast cancer death rates by state and race from 1975 to 2004 [13]. This method fits a series of joined straight lines on a log scale to the trends in age-adjusted rates, with each junction or “joinpoint” denoting a statistically significant change in trend. The overall significance was set at $p = 0.05$, with a maximum of three joinpoints and four line segments allowed. An annual percent change (APC) was used to describe the trend for each line segment. In describing trends, we use the terms “increase” or “decrease” when the slope of the line segment is statistically different from zero; otherwise we use the terms “stable” or “level.”

The temporal trend among African American women could not be evaluated in 13 states that had no recorded deaths from breast cancer in at least one of the study years. Therefore, our analyses of trend include 37 states and the District of Columbia (DC) for African American women and all 50 states and DC for white women.

Results

Figure 1 illustrates the temporal trends in breast cancer mortality and incidence rates that occurred nationally in African American and white women from 1975 through 2004. Before 1980, death rates were lower for African Americans than whites; subsequently, death rates rose much more markedly in African American than white women. Although death rates began to decline in 1990 for white women and in 1991 for African American women, the decline in the death rates has been substantially larger in white than in African American women (2.4% per year vs. 1.2% per year, respectively). The ratio of the age-standardized death rates among African American women compared to white women increased from 1.18 (95% CI, 1.14–1.22) in 1991 to 1.36 (95% CI, 1.32–1.39) in 2004, despite lower incidence rates in African American women. After increasing for many years, breast cancer incidence rates began to decline in 2001 in white women. In contrast, incidence rates have remained relatively stable in African American women since 1992.

Joinpoint analyses of the trends in breast cancer death rates are presented for the nation, regions, and each state by race in Table 1. Death rates have decreased in the most recent time period (the last joinpoint segment) among white women in all states and in DC, however the onset and the rate of decrease has not been uniform. The decline in death rates among whites in most states began approximately in 1990, although it began much earlier in states such as Massachusetts, Hawaii, and DC. During the mid-1990s, the decline in breast cancer mortality rates began to

Fig. 1 Trends in female breast cancer mortality and incidence rates by race, U.S., 1975–2004

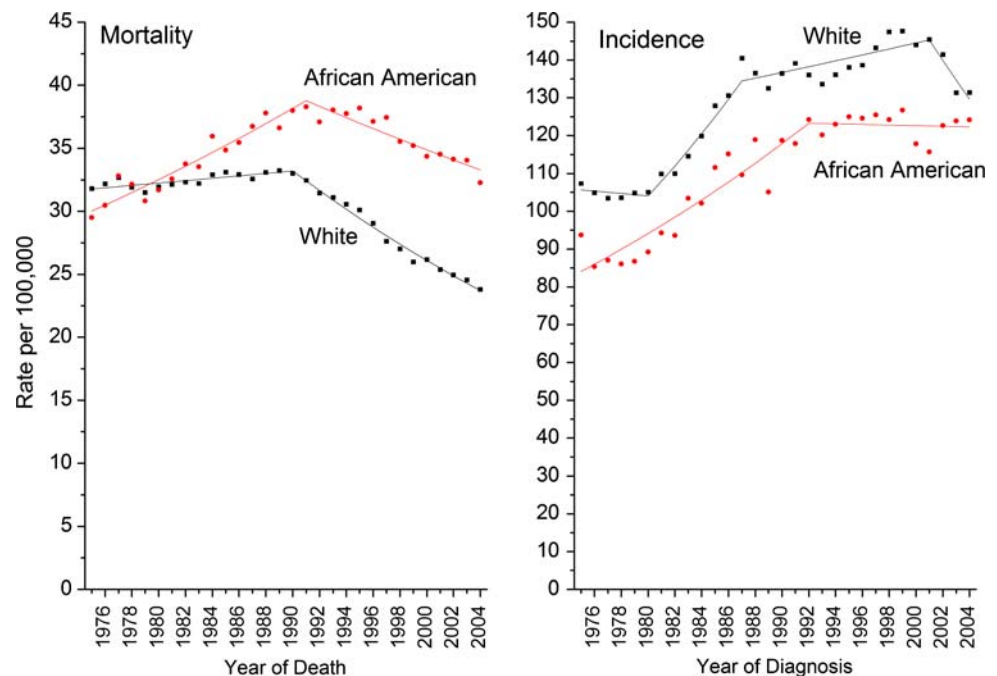


Table 1 Trends in female breast cancer death rates by state and race, according to joinpoint analyses^a, U.S., 1975–2004

Region/ State	Race	Death rate ^b 2003–2004	Trend 1		Trend 2		Trend 3		Trend 4	
			Years	Annual % change	Years	Annual % change	Years	Annual % change	Years	Annual % change
U.S.	White	24.2	1975–1990	0.3 ^c	1990–2004	–2.4 ^c				
	Black	33.1	1975–1991	1.6 ^c	1991–2004	–1.2 ^c				
Northeast	White	25.6	1975–1990	0.1	1990–2004	–2.8 ^c				
	Black	29.6	1975–1994	0.6 ^c	1994–2004	–2.5 ^c				
Connecticut	White	24.1	1975–1987	–0.6	1987–2004	–2.2 ^c				
	Black	25.7	1975–2004	–0.1						
Maine	White	24.2	1975–1991	0.0	1991–2004	–2.7 ^c				
	Black	–	–							
Massachusetts	White	24.6	1975–1984	1.2 ^c	1984–1993	–1.1 ^c	1993–2004	–3.5 ^c		
	Black	25.8	1975–1994	1.3	1994–2004	–5.3 ^c				
New Hampshire	White	24.2	1975–1990	1.1 ^c	1990–2004	–3.6 ^c				
	Black	–	–							
New Jersey	White	27.0	1975–1990	0.1	1990–2004	–2.6 ^c				
	Black	33.7	1975–1991	1.5 ^c	1991–2004	–1.9 ^c				
New York	White	25.2	1975–1989	0.0	1989–1996	–2.2 ^c	1996–2004	–3.6 ^c		
	Black	27.9	1975–1995	0.3	1995–2004	–2.7 ^c				
Pennsylvania	White	26.7	1975–1990	0.5 ^c	1990–2004	–2.4 ^c				
	Black	33.0	1975–2004	0.0						
Rhode Island	White	23.0	1975–1991	0.1	1991–2004	–3.8 ^c				
	Black	–	1975–2004	–1.5						
Vermont	White	25.4	1975–1987	1.3 ^c	1987–2004	–2.6 ^c				
	Black	–	–							
Midwest	White	24.3	1975–1990	0.3 ^c	1990–2004	–2.5 ^c				
	Black	35.4	1975–1988	1.6 ^c	1988–2004	–0.6 ^c				
Illinois	White	24.1	1975–1991	0.2 ^c	1991–2004	–3.0 ^c				
	Black	38.8	1975–1986	2.0 ^c	1986–2004	–0.1				
Indiana	White	24.9	1975–1989	0.6 ^c	1989–2004	–2.1 ^c				
	Black	32.2	1975–2004	0.0						
Iowa	White	22.6	1975–1992	0.3	1992–2004	–3.0 ^c				
	Black	–	–							
Kansas	White	24.2	1975–1989	0.4	1989–2004	–1.8 ^c				
	Black	38.2	1975–2004	1.0						
Michigan	White	23.4	1975–1990	0.1	1990–2004	–2.6 ^c				
	Black	33.4	1975–1977	15.1	1977–1990	1.7 ^c	1990–2004	–1.3 ^c		
Minnesota	White	22.8	1975–1990	0.5	1990–2004	–2.9 ^c				
	Black	28.1	1975–2004	–0.9						
Missouri	White	25.1	1975–1989	0.7 ^c	1989–2004	–1.9 ^c				
	Black	37.4	1975–1977	–15.6	1977–1983	6.6	1983–2004	–0.3		
Nebraska	White	23.0	1975–1990	0.5	1990–2004	–2.9 ^c				
	Black	–	1975–2004	2.3						
North Dakota	White	22.9	1975–1992	–0.3	1992–2004	–2.6 ^c				
	Black	–	–							
Ohio	White	26.6	1975–1989	0.3	1989–2004	–2.1 ^c				
	Black	35.0	1975–2004	–0.2						

Table 1 continued

Region/ State	Race	Death rate ^b 2003–2004	Trend 1		Trend 2		Trend 3		Trend 4	
			Years	Annual % change	Years	Annual % change	Years	Annual % change	Years	Annual % change
South Dakota	White	24.4	1975–2004	–1.3 ^c						
	Black	–	–							
Wisconsin	White	23.4	1975–1990	0.0	1990–2004	–2.7 ^c				
	Black	26.1	1975–2004	–0.1						
West	White	23.9	1975–1990	0.2	1990–2004	–2.3 ^c				
	Black	31.2	1975–1985	2.4 ^c	1985–2004	–1.1 ^c				
Alaska	White	19.8	1975–2004	–1.3 ^c						
	Black	–	–							
Arizona	White	22.3	1975–1990	0.6	1990–2004	–2.2 ^c				
	Black	34.1	1975–2004	0.9						
California	White	24.0	1975–1990	0.0	1990–2004	–2.5 ^c				
	Black	33.7	1975–1985	2.6 ^c	1985–2004	–0.9 ^c				
Colorado	White	23.4	1975–1990	0.5	1990–2004	–2.2 ^c				
	Black	18.0	1975–2004	–1.0						
Hawaii	White	22.8	1975–1981	7.2	1981–2004	–1.8 ^c				
	Black	–	–							
Idaho	White	23.5	1975–2000	–0.8 ^c						
	Black	–	–							
Montana	White	22.5	1975–1990	0.7	1990–2004	–2.4 ^c				
	Black	–	–							
Nevada	White	26.8	1975–2004	–0.7 ^c						
	Black	29.0	1975–2004	–0.5						
New Mexico	White	24.3	1975–1987	1.9 ^c	1987–2004	–1.8 ^c				
	Black	–	–							
Oregon	White	25.6	1975–1988	0.7	1988–2004	–1.6 ^c				
	Black	–	1975–1982	12.6	1982–2004	–4.2 ^c				
Utah	White	23.3	1975–1977	14.9	1977–2004	–0.8 ^c				
	Black	–	–							
Washington	White	24.2	1975–1980	–2.3	1980–1989	1.1	1989–2004	–2.5 ^c		
	Black	23.1	1975–2004	–1.5 ^c						
Wyoming	White	24.7	1975–1991	1.2	1991–2004	–2.7 ^c				
	Black	–	–							
South	White	23.4	1975–1990	0.8 ^c	1990–2004	–2.0 ^c				
	Black	33.9	1975–1993	1.9 ^c	1993–2004	–1.4 ^c				
Alabama	White	23.2	1975–1984	1.7 ^c	1984–2004	–1.1 ^c				
	Black	30.4	1975–1990	2.8 ^c	1989–2004	–1.7 ^c				
Arkansas	White	22.8	1975–1984	–0.9	1984–1987	7.0	1987–2004	–1.6 ^c		
	Black	33.1	1975–2004	1.9 ^c						
Delaware	White	24.7	1975–1988	1.9 ^c	1988–2004	–3.2 ^c				
	Black ^d	31.4	1975–1978	51.9 ^c	1978–2004	–1.1				
DC	White	24.2	1975–2004	–1.8 ^c						
	Black	32.0	1975–1996	1.2 ^c	1996–2004	–4.9 ^c				
Florida	White	22.4	1975–1992	0.2	1992–2004	–2.9 ^c				
	Black	29.6	1975–1988	3.0 ^c	1988–2004	–1.2 ^c				

Table 1 continued

Region/ State	Race	Death rate ^b 2003–2004	Trend 1		Trend 2		Trend 3		Trend 4	
			Years	Annual % change	Years	Annual % change	Years	Annual % change	Years	Annual % change
Georgia	White	24.1	1975–1988	1.8 ^c	1988–2004	–1.6 ^c				
	Black	32.0	1975–1988	3.4 ^c	1988–2004	–0.7				
Kentucky	White	23.9	1975–1989	1.0 ^c	1989–2004	–1.6 ^c				
	Black	39.6	1975–2004	0.0						
Louisiana	White	24.5	1975–1995	0.4	1995–2004	–2.2 ^c				
	Black	41.2	1975–1990	2.8 ^c	1990–2004	0.0				
Maryland	White	24.8	1975–1989	–0.2	1989–2003	–2.3 ^c				
	Black	33.9	1975–2004	–0.1						
Mississippi	White	23.6	1975–1989	1.0 ^c	1989–2004	–1.0 ^c				
	Black	35.4	1975–2004	1.8 ^c						
North Carolina	White	23.5	1975–1988	1.4 ^c	1988–2004	–2.0 ^c				
	Black	33.7	1975–1988	2.7 ^c	1988–2004	–0.7				
Oklahoma	White	24.2	1975–1994	0.8 ^c	1994–2004	–2.4 ^c				
	Black	34.0	1975–2004	0.5						
South Carolina	White	21.6	1975–1988	1.6 ^c	1988–2004	–2.3 ^c				
	Black	31.0	1975–1997	2.0 ^c	1997–2004	–2.8				
Tennessee	White	24.9	1975–1992	0.9 ^c	1992–2004	–1.7 ^c				
	Black	38.7	1975–1991	2.2 ^c	1991–2004	–1.6 ^c				
Texas	White	22.8	1975–1983	–0.4	1983–1992	1.3 ^c	1992–2004	–2.1 ^c		
	Black	36.6	1975–1993	2.1 ^c	1993–2004	–0.8				
Virginia	White	24.6	1975–1978	–3.4	1978–1985	2.8 ^c	1985–1990	–0.3	1990–2004	–2.2 ^c
	Black	35.0	1975–1994	1.5 ^c	1994–2004	–1.7 ^c				
West Virginia	White	25.0	1975–1987	1.9 ^c	1987–2004	–1.4 ^c				
	Black	–	1975–2004	1.0						

^a Joinpoint Regression Program version 3.0 (National Cancer Institute/US National Institutes of Health, Bethesda, MD). The annual % change is based on rates that were age-adjusted to the 2000 US standard population using joinpoint regression analysis and include up to three joinpoints

^b Rates per 100,000 age-adjusted to the 2000 US Standard population. Death rate not shown if based on fewer than 25 deaths

^c The annual % change is statistically significantly different from zero (two-sided $p < 0.05$)

^d Annual % change during 1975–1978 based upon sparse data

accelerate in Massachusetts and New York. Examining the trends by region, death rates decreased faster in the Northeast (2.8% per year) compared to the South (2.0% per year).

Table 1 also presents the trends among African American women in DC and the 37 states where the number of deaths was sufficient to examine these trends. During the most recent time period (the last joinpoint segment), death rates decreased in 11 states and DC, were level by joinpoint analyses in 24 states, and increased in two states: Arkansas and Mississippi. Many of the states in which the breast cancer death rates in African American women were level or rising were in the South (12/17) and Midwest (8/12, data could not be evaluated in three Midwestern states). Death

rates declined faster in the Northeast (2.5% per year since 1994) compared to other U.S. regions.

Figure 2 shows temporal trends in breast cancer death rates for states that illustrate extremes of variation, especially among African American women. In Arkansas, death rates have increased by 1.9% per year in African American women since 1975, whereas the death rate has declined by 1.6% per year since 1987 among white women. Likewise in Mississippi, death rates increased in African American women from 1975 to 2004 by 1.8% per year and decreased among white women by 1.0% per year since 1989. In contrast, the death rates in New York and Florida have decreased in both African American and white women, although the decreases are steeper in whites.

Fig. 2 Trends in breast cancer mortality rates among African American and white women for selected states, 1975–2004

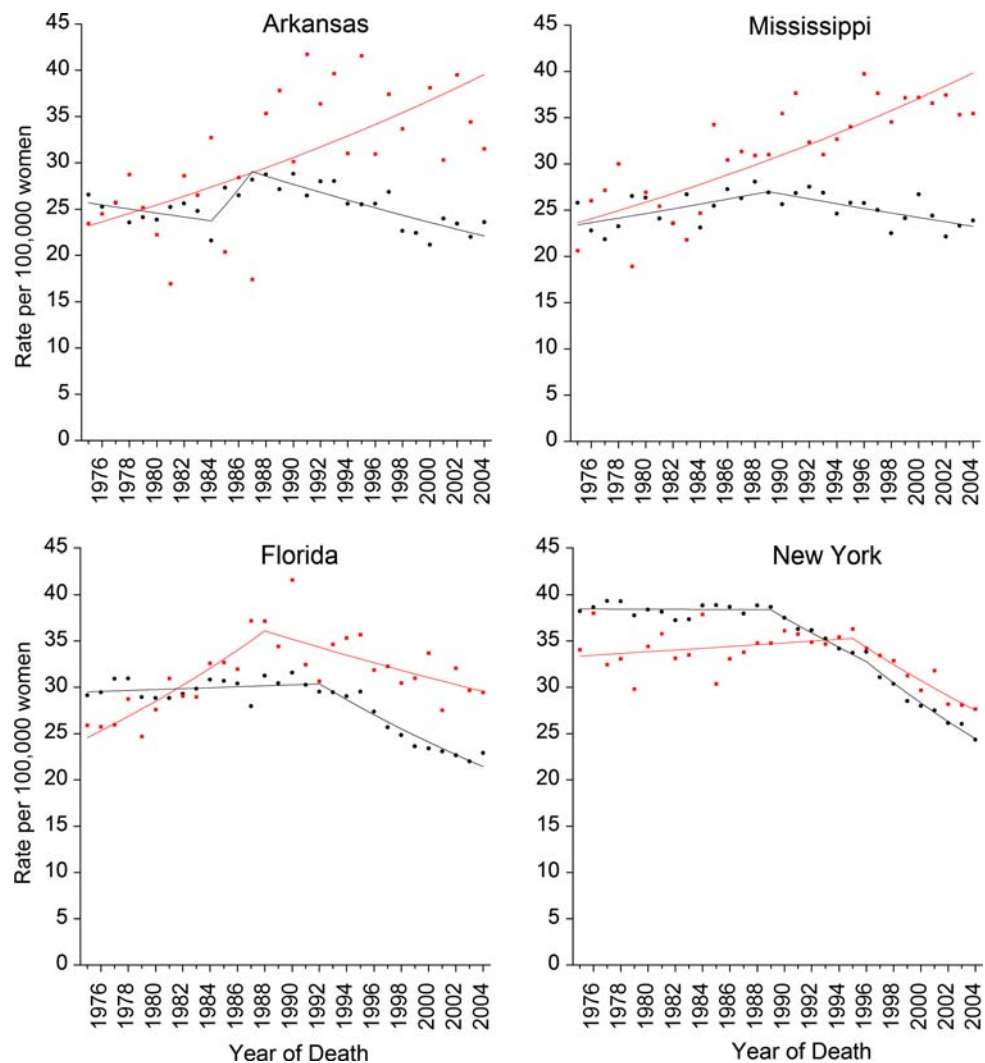


Figure 3 illustrates the distribution of states according to their average, annual breast cancer death rates during 2003–2004 by race. State-specific rates range from 18.0 to 41.2 per 100,000 for African American women and from 19.8 to 27.0 per 100,000 for white women. There is minimal overlap in the distribution of breast cancer death rates in African American and white women by state. In 32 of 37 states and DC, the death rate among African American women exceeded the 95th percentile of the distribution in white women. In general, states that showed little progress in reducing breast cancer mortality rates over time had higher death rates in 2003–2004.

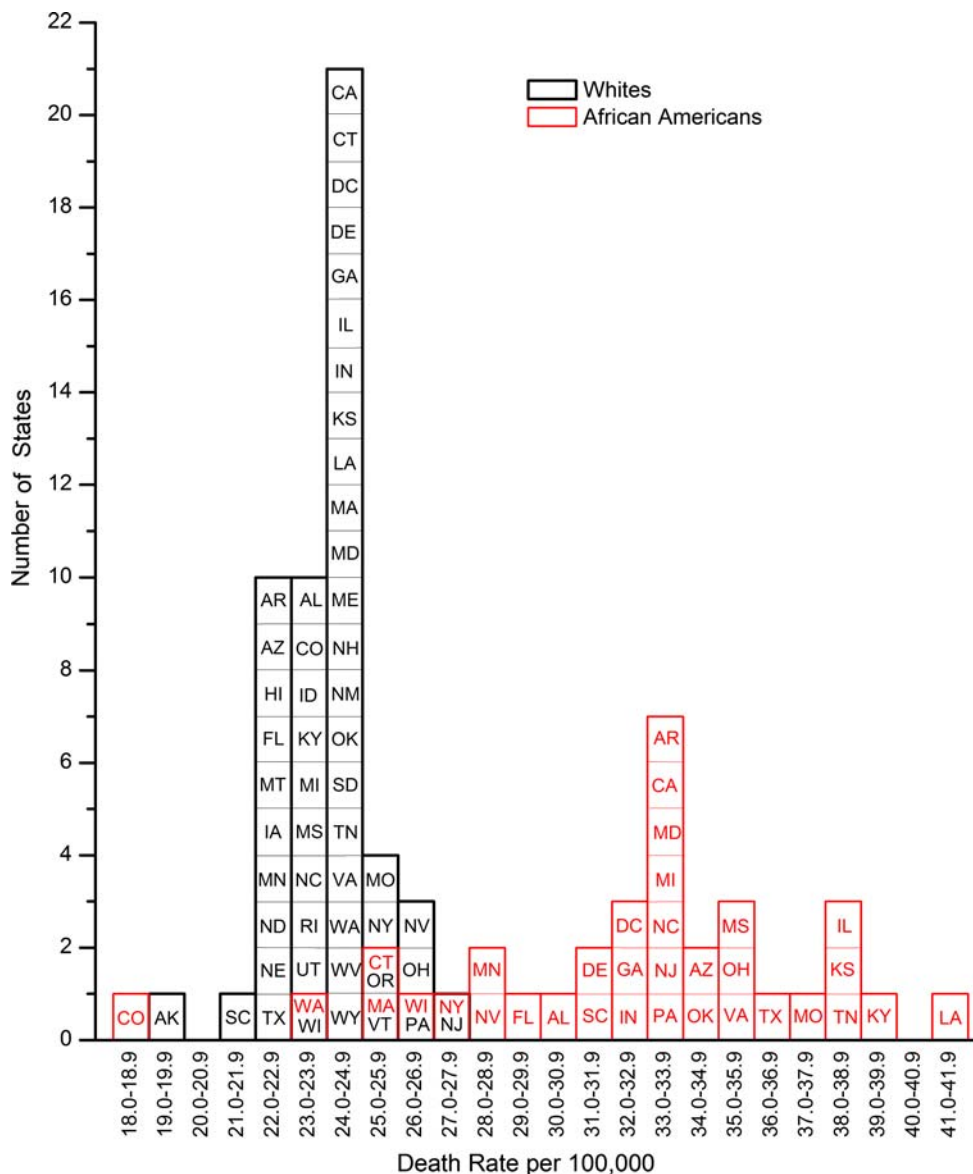
Discussion

Our principal findings are that the temporal trends in breast cancer death rates vary widely by state and are considerably less favorable in African American than in white women. The death rate in African American women

decreased in only 11 of 37 states and DC, compared to decreases in all 50 states and DC among white women. Notably, from 1975 to 2004, the death rate increased rather than decreased among African American women in two states: Arkansas and Mississippi. In general, states that showed little progress in reducing breast cancer mortality rates over time had higher death rates in 2003–2004.

Variation in the prevalence and quality of mammography screening across states and between races is likely to contribute to the observed state variations in breast cancer mortality [2, 8]. Although a report on mammography trends by state indicates that mammography use increased significantly between 1991 and 2000 in 43 of 47 states analyzed (all except Alaska, Colorado, Minnesota, and Washington) [8], some states continue to have low rates of mammography screening, particularly among African American women. For example, in 2004, 46% of African American women age 40 and older living in Mississippi and 51% in Arkansas reported having a mammogram in the previous year compared to 62% in Florida and 57% in

Fig. 3 Distribution of states in relation to female breast cancer death rates in African American and white women, 2003–2004



New York [2]. The National Breast and Cervical Cancer Early Detection Program (NBCCEDP) is a federal program to help low-income women gain access to timely, high-quality breast and cervical cancer screening; however in many states only a small percentage of the eligible women are receiving mammography. According to data from the program, the proportion of eligible women receiving a program-funded mammogram during 2002–2003 varied by state from 2% to 79%, with an average of 13% nationally [14]. There is also considerable evidence that despite increases in reported mammography screening rates, African American women remain less likely to receive adequate screening at recommended intervals [15] and receive appropriate follow-up following an abnormal mammogram [16] and thus are more likely to be diagnosed at later stages [17, 18].

Regional variations in the quality and timeliness of treatment are other factors that likely contribute to the geographic variation in the rate of progress in reducing breast cancer mortality [5–7, 19, 20]. Osteen et al. reported that women in the central and eastern southern states (Kentucky, Tennessee, Mississippi, and Alabama) were less likely to receive combinations of surgery with radiation therapy or chemotherapy or both compared to women in other regions [20]. Low-income women of all races and African American women in particular, are less likely to receive prompt, high-quality treatment [21–23]. Furthermore, African American women and poorer women are more likely to experience delays in diagnosis and treatment [24].

Access to and utilization of early detection and treatment services are limited by low socioeconomic status [25, 26]. In ten of the 26 states with no evidence of decreasing breast

cancer death rates in African American women, the percentage of people living in poverty was above the U.S. average (12.4%), according to the 2000 census [27]. These ten states include Arizona, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, Oklahoma, South Carolina, Texas, and West Virginia. In general, higher rates of poverty and uninsurance exist in the South than in other regions of the U.S. and among African Americans compared to whites [27, 28]. For example, in 1999, 19.9% of Mississippians and 15.8% of the population of Arkansas, the two states experiencing increasing mortality rates in African American women, were below the poverty level, compared to 12.4% of the national population [27]. Likewise, 23% of women (ages 18–64 years) in Mississippi and 22% of women in Arkansas lacked health insurance coverage during 2000–2002 compared to the national average of 16% [29].

Variation in incidence rates may also contribute to the observed variations in mortality rates. As shown in Fig. 1, delay-adjusted breast cancer incidence trends for African American women in the SEER 9 areas increased by 2.3% per year from 1975 to 1992 and were stable from 1992 to 2004 [30]. However, long-term incidence data are not available to examine temporal trends in breast cancer incidence rates by state; therefore the extent to which increasing mortality rates are associated with increasing incidence rates in these states is not certain. Breast cancer incidence trends are influenced by trends in underlying risk factors (age at first birth, number of children, use of hormone replacement therapy and post-menopausal obesity) as well as trends in the prevalence of mammography [2]. It is likely that increasing mortality rates in Arkansas and Mississippi are in part due to true underlying increases in risk of disease related to temporal patterns of reproductive and other risk factors which may differ among African American women in poor, rural areas of the South compared to the U.S. as a whole [4]. Nonetheless, it is important to note that differences in incidence trends and rates do not explain differences in mortality trends between African American and white women observed in most states. Among all states with cancer registries meeting quality standards, incidence rates are consistently lower among African American women while mortality rates are consistently higher [2]. Furthermore, incidence rates have increased more rapidly in white women compared to African American women according to combined data from the 9 SEER registries (Fig. 1) as well as data from each of the 13 SEER cancer registries (data not shown).

Access to quality mammography screening and treatment are two factors that likely contribute to the breast cancer mortality disparities we have identified at the state level. Both of these factors are amenable to intervention by state cancer control efforts. For example, in 2000, Mississippi and Alabama created a partnership, the Deep South

Network for Cancer Control, to address cancer disparities in targeted underserved communities within these states [31]. Prior to this initiative, Mississippi had little to no infrastructure for cancer control, particularly within African American and underserved communities. As a result of these efforts, there have been considerable improvements in screening rates and the prevalence of other cancer awareness activities in the targeted communities and an infrastructure has been created to facilitate continued improvements within the state [31]. One of the future aims of this program is to increase involvement in clinical trials, especially among African American women in Mississippi, which may increase access to new and improved breast cancer therapies.

This study has several limitations. Analyses of mortality data based on death certificates are dependent on the quality of the information recorded. Although breast cancer deaths are recorded with high accuracy, there may be some geographical variation in the quality of death certificates which may contribute to the observed trends [32]. A second limitation of this study is that it is descriptive and we can only speculate about the factors that have contributed to the differing rates of progress against breast cancer in states.

Conclusion

While death rates from breast cancer have decreased for white women in every state and DC, death rates have increased or remain level for African American women in 26 states. These states in particular should focus their cancer control efforts to increase health awareness within underserved communities and to ensure that all women have access to high-quality early detection and treatment services.

References

- Berry DA, Cronin KA, Plevritis SK et al (2005) Effect of screening and adjuvant therapy on mortality from breast cancer. *N Engl J Med* 353:1784–1792
- Smigal C, Jemal A, Ward E et al (2006) Trends in breast cancer by race and ethnicity: update 2006. *CA Cancer J Clin* 56:168–183
- Sturgeon SR, Schairer C, Gail M, McAdams M, Brinton LA, Hoover RN (1995) Geographic variation in mortality from breast cancer among white women in the United States. *J Natl Cancer Inst* 87:1846–1853
- Sturgeon SR, Schairer C, Grauman D, El Ghormli L, Devesa S (2004) Trends in breast cancer mortality rates by region of the United States, 1950–1999. *Cancer Causes Control* 15:987–995
- Jatoi I, Anderson WF, Rao SR, Devesa SS (2005) Breast cancer trends among black and white women in the United States. *J Clin Oncol* 23:7836–7841
- Goodwin JS, Freeman JL, Freeman D, Nattinger AB (1998) Geographic variations in breast cancer mortality: do higher rates imply elevated incidence or poorer survival? *Am J Public Health* 88:458–460

7. Farrow DC, Hunt WC, Samet JM (1992) Geographic variation in the treatment of localized breast cancer. *N Engl J Med* 326:1097–1101
8. Nelson DE, Bland S, Powell-Griner E et al (2002) State trends in health risk factors and receipt of clinical preventive services among US adults during the 1990s. *JAMA* 287:2659–2667
9. Surveillance, Epidemiology, and End Results (SEER) Program (<http://www.seer.cancer.gov>) Delay-Adjusted Incidence database: “SEER Incidence Delay-Adjusted Rates, 9 Registries, 1975–2004”. National Cancer Institute, DCCPS, Surveillance Research Program, Statistical Research and Applications Branch, released April 2007, based on the November 2006 SEER data submission
10. Clegg LX, Feuer EJ, Midthune DN et al (2002) Impact of reporting delay and reporting error on cancer incidence rates and trends. *J Natl Cancer Inst* 94:1537–1545
11. Surveillance, Epidemiology, and End Results (SEER) Program (<http://www.seer.cancer.gov>) SEER*Stat Database: Mortality - All COD, Public-Use With State, Total U.S. (1969–2004), National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2007. Underlying mortality data provided by NCHS (<http://www.cdc.gov/nchs>)
12. Surveillance Research Program, National Cancer Institute SEER*Stat software (<http://www.seer.cancer.gov/seerstat>) version 6.3.5
13. Kim HJ, Fay MP, Feuer EJ, Midthune DN (2000) Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med* 19:335–351
14. Tangka FK, Dalaker J, Chattopadhyay SK et al (2006) Meeting the mammography screening needs of underserved women: the performance of the National Breast and Cervical Cancer Early Detection Program in 2002–2003 (United States). *Cancer Causes Control* 17:1145–1154
15. Smith-Bindman R, Miglioretti DL, Lurie N et al (2006) Does utilization of screening mammography explain racial and ethnic differences in breast cancer? *Ann Intern Med* 144:541–553
16. Jones BA, Dailey A, Calvocoressi L et al (2005) Inadequate follow-up of abnormal screening mammograms: findings from the race differences in screening mammography process study (United States). *Cancer Causes Control* 16:809–821
17. Weir HK, Thun MJ, Hankey BF et al (2003) Annual report to the nation on the status of cancer, 1975–2000, featuring the uses of surveillance data for cancer prevention and control. *J Natl Cancer Inst* 95:1276–1299
18. Ward E, Jemal A, Cokkinides V et al (2004) Cancer disparities by race/ethnicity and socioeconomic status. *CA Cancer J Clin* 54:78–93
19. Nattinger AB, Gottlieb MS, Veum J, Yahnke D, Goodwin JS (1992) Geographic variation in the use of breast-conserving treatment for breast cancer. *N Engl J Med* 326:1102–1107
20. Osteen RT, Karnell LH (1994) The National Cancer Data Base report on breast cancer. *Cancer* 73:1994–2000
21. Shavers VL, Brown ML (2002) Racial and ethnic disparities in the receipt of cancer treatment. *J Natl Cancer Inst* 94:334–357
22. Bradley CJ, Given CW, Roberts C (2002) Race, socioeconomic status, and breast cancer treatment and survival. *J Natl Cancer Inst* 94:490–496
23. Haggstrom DA, Quale C, Smith-Bindman R (2005) Differences in the quality of breast cancer care among vulnerable populations. *Cancer* 104:2347–2358
24. Gwyn K, Bondy ML, Cohen DS et al (2004) Racial differences in diagnosis, treatment, and clinical delays in a population-based study of patients with newly diagnosed breast carcinoma. *Cancer* 100:1595–1604
25. Brawley OW (2002) Disaggregating the effects of race and poverty on breast cancer outcomes. *J Natl Cancer Inst* 94:471–473
26. Bach PB, Schrag D, Brawley OW, Galaznik A, Yakren S, Begg CB (2002) Survival of blacks and whites after a cancer diagnosis. *JAMA* 287:2106–2113
27. Bishaw A, Iceland J (2003) Poverty: 1999, Census 2000 Brief. Economics and Statistics Administration: US Census Bureau, C2KBR-19
28. Nelson DE, Bolen J, Wells HE, Smith SM, Bland S (2004) State trends in uninsurance among individuals aged 18 to 64 years: United States, 1992–2001. *Am J Public Health* 94:1992–1997
29. Department of Health and Human Services (2005) Office of Public Health and Science, Office on Women’s Health. Quick Health Data Online, 2007, Washington, DC
30. Ries LAG, Melbert D, Krapcho M et al. SEER Cancer Statistics Review, 1975–2004, National Cancer Institute. Bethesda, MD, http://www.seer.cancer.gov/csr/1975_2004/, based on November 2006 SEER data submission, posted to the SEER web site, 2007
31. Lisovicz N, Johnson RE, Higginbotham J et al (2006) The Deep South Network for cancer control. Building a community infrastructure to reduce cancer health disparities. *Cancer* 107:1971–1979
32. Percy C, Stanek E, Gloeckler L (1981) Accuracy of death certificates and its effect on cancer mortality statistics. *Am J Public Health* 71:242–250